The agreement between the two pressure curves, Little Rock and St. Louis, is very striking, and tends to confirm the theory that there is a partial vacuum or core of greatly diminished pressure at the center of the tornado vortex, caused by the centrifugal force of the gyrations. The marked oscillations of pressure after the passage of the tornado are also important as evidence of the greatly disturbed equilibrium of the atmosphere and the gradual return to normal conditions.

The amount of pressure fall in the vortex is still unknown, and, from the nature of the case, will probably always remain so. The Weather Bureau office in St. Louis, where the fall of pressure at the moment of the tornado's passage was one-third of an inch, was probably three-quarters of a mile from the center of low pressure. The sudden removal of one-third of an inch of pressure, as measured by the mercurial barometer, corresponds roughly to a pressure of 22 pounds per square foot of surface. This must then be an approximation to the force exerted by the expansion of air of ordidary density confined within buildings in the neighborhood of the Weather Bureau office. The explosive force in the tornado's path was of course vastly greater than on either side, but we have no means of measuring its intensity, unless we accept the reading of the aneroid referred to in Mr. Frankenfield's note of June 23. Further details as to the condition of the aneroid before and after the tornado will be obtained if possible, and published in a subsequent REVIEW.

It is regretted that a record of the direction of the wind at less intervals than five minutes can not be obtained. In reading the record of direction on Chart IX it should be remembered that the directions given are those that prevailed for an instant of time only at 5-minute intervals. Southeasterly winds prevailed from 2 to 5.40 p. m., there being not the slightest variation from that direction. These winds again reappeared at the surface after the tornado had passed, viz, from 6.55 to 7.15 p. m., and again from 9.25 to 10.05 p. m. Thereafter, until 1.30 a. m. of the 28th, the winds were southerly or southwesterly. From 1.30 a. m. until noon of the 28th, the winds were generally northwesterly, occasionally backing to westerly. It may be of interest to note that the southeasterly winds and the oscillations of the barometer ceased at the same time. The velocity record is quite similar to that of a thunderstorm or squall wind. In the Louisville tornado the maximum velocity was but 36 miles per hour, although the tornado path was less than 600 yards from the Weather Bureau office. The wind was also quite moderate on either side of the Sherman tornado. The fact that the greatest damage was done to upper stories, and that there seemed to be a limit below which the force of the tornado was not felt, was also noticed in the Louisville tornado.

The ordinary funnel cloud seems not to have been fully developed in either the St. Louis or Louisville tornado. In the Sherman, Tex., tornado of May 15, 1896, the tornado cloud was seen and accurately described by several persons. The following from an interview with Prof. A. Q. Nash, of the Sherman Institute (Globe Democrat, St. Louis, May 22 1896), is so clear and explicit as to the updraft and the whirling motion that it is here reproduced:

When the cloud passed in front of me it seemed to be going at the speed of a galloping horse. The speed was not so great but that almost any one running to the east or to the west could have got out of the way. The cloud swelled out above the ground, but the top of it was higher than the sides. It seemed to be churning up all that it touched and throwing out the fragments at the top. The shape and action was much like a geyser. At the same time, as it moved along, the mass had a rotary motion. It whirled round and round in a direction from right over to left, just the reverse of the movements of the hands of a watch.

Only the outlines of the mass could be distinguished. It was impossible to see into it. Houses and other things went up as the cloud reached them, disappearing in the revolving interior. At the top and around the edges I could see things whirling and then falling as they got beyond the edges. The revolving velocity was so great it set the adjacent air in motion, and the lighter things, such as leaves and twigs, and bits of pine and particles of mud, circled far outside of the cloud and fell at considerable distances from the path of the cyclone. In the short time I stood there watching the cloud pass I was covered with mud and drenched with muddy water. As the cloud passed the rotary motion could be seen very plainly in the rear.

The path of greatest destruction in the St. Louis tornado extended from Randolph County, Mo., to Jefferson County, Ill., a distance of about 200 miles. After leaving St. Louis a score or more of towns and villages was passed over and 39 lives were lost before the fury of the storm abated.

The scene of tornadic activity was transferred on the following day to southern-central und southeastern Pennsylvania. The center of the general storm was over the lower Lakes, but it will be observed that the region of tornadoes maintained the same relative position to the storm center as on the previous day. The first appearance of a tornado on the 28th was at Columbia, Pa., at 1.30 p. m. One person was killed and 20 injured by the wrecking of a large rolling mill. An eye witness of the storm, Mr. T. L. Urban, describes its approach as follows:

* * * Approaching the window and looking to the northwest I beheld a black cloud, like a great monster about to leap into the river, when, like a flash, and to my surprise and horror, it lifted its colossal form from the bosom of the water in a rotary form. Propelled by the cyclone force it neared the shore; then began the most appalling sight it has been my province to witness. * * * Spellbound I gazed at its approach whirling round and round with a roaring noise, water and mud in advance. It struck the shore, when the black cloud seemingly shot upward, and beneath it I beheld the air filled with flying objects; one huge black mass seemed coming directly towards me. * * * In a whirlwind form it came directly towards me, when to my agreeable surprise on reaching the railroad it took a south, thence southeasterly, course and continued on, leaving in its wake desolation and destruction.

After leaving Columbia the tornado appears to have spent its force, although severe winds and thunderstorms were experienced to the northeastward as far as Easton. A second series of tornadoes swept through Montgomery and Bucks counties to the New Jersey line. Four people were killed and the property loss was quite large. A third series appears to have passed through southern New Jersey, but no lives were lost and the damage was confined principally to the destruction of fences, outbuildings, and barns.

## NOTE BY THE CHIEF.

**Certain interviews with Prof. H. A. Hazen, U. S. Weather Bureau, have recently appeared in the public press, in which the planting of forests on the southwestern edge of cities and the discharge of dynamite bombs have been advocated as a protection against tornadoes.**

**It should be clearly understood that the Weather Bureau—using that term as expressing the collective thought of its Chief and members of the scientific staff, Professor Hazen alone excepted—does not indorse the theories set forth in the interviews above referred to. The opinions expressed and the methods of executing them are Professor Hazen's, and he alone is responsible for them.**

**That there may be no misunderstanding in the matter, the following letter has been sent to the managing editors of the various journals that have commented upon the interviews above mentioned:**

**"I have to inform you that these statements were not authorized by the Weather Bureau, and that the theories advanced are not held by scientific men generally. The interview came from Professor Hazen as a private individual, and not in his capacity as an official of this Bureau.**

**"From personal observation of the havoc wrought by several tornadoes, I am fully convinced that any attempt to destroy them by the means suggested will be a failure."**

**June 24, 1896. WILLIS L. MOORE.**